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## Rehabilitation for Cochlear Implant Patients

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### I. INTRODUCTION

Australian 22-channel cochlear prostheses were implanted in several postlingual profound deaf patients who subsequently have obtained good communication ability. Many reports have been made on the preoperative and postoperative auditory evaluation of the cochlear implant. However, the main emphasis has been laid on surgical technique of cochlear implants, electrode coding strategy, postoperative auditory training and evaluation <sup>1)2)3)4)</sup>, and not on rehabilitation including psychophysical counseling and guidance on every day living. Through our clinical experience with cochlear implant patients, it is obvious that the postoperative auditory status is not the only factor to determine the patients' overall communication ability and adaptability to social life. The psychological factor can not be neglected. Therefore, the rehabilitation program for cochlear implant patients should include psychological and behavioral counseling. Here we describe our rehabilitation program for two psychologically different patients.

### II. METHOD

1) The improvement of auditory ability was evaluated by vowel discrimination test, consonant discrimination test and speech tracking test<sup>5)</sup>. These evaluations were performed once a week and the time course changes were examined.

2) Psychological status and behavior were evaluated by the conventional tests, such as Yatabe-Guilford (Y-G) test, and by a questionnaire. These tests were performed preoperatively and three months after the beginning of rehabilitation.

### III. CASE REPORTS

Patient 1. A 55-year old male carpenter had fallen down from a three-meter height. X-ray of the head showed bilateral temporal bone fracture. Pure tone audiometry showed bilateral total deafness (Fig. 1). Cochlear implantation was

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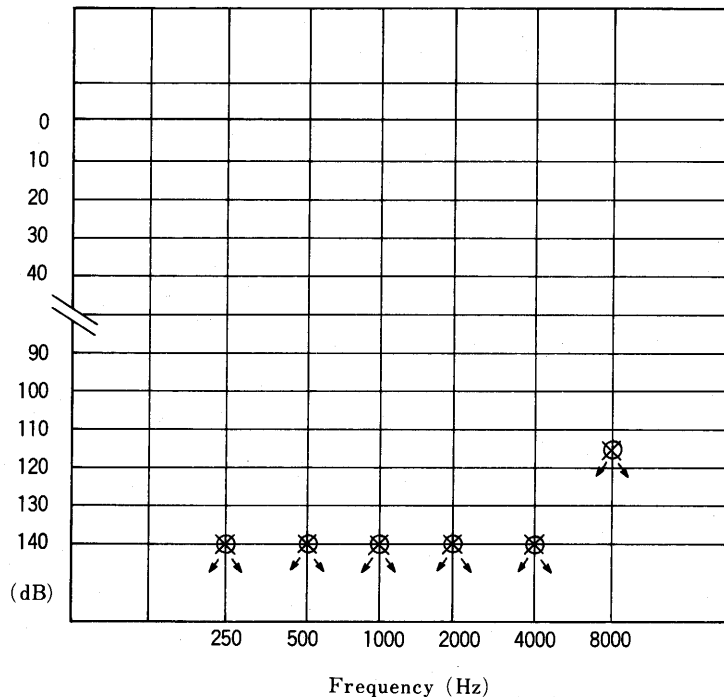


Fig. 1. Pure tone audiogram : Patient 1.

performed one year and eight months after the accident.

**Patient 2.** A 49-year old male office worker had suffered from the bilateral deaf for twelve years. The cause of deafness is unknown. Figure 2 shows the pure tone audiogram. Using a booster, the patient had a hearing response bilaterally at 250 Hz-1000 Hz, and 2000 Hz on the right ear, at the level of 115-135 dB.

High power hearing aids were ineffective in both patients. Their lip reading abilities were poor, and they had communicated by writing.

#### IV. RESULTS

##### 1) Rehabilitation course

###### (1) Patient 1

All of the implant's 22 electrodes could be used. One week after the beginning of rehabilitation, the patient could understand simple conversation and the sound of an automobile, and he could distinguish the voice of his wife from that of other persons. We recommended him to walk outside the hospital in order to listen to the social sound. He was told to write down the sounds he could recognize. After three weeks he could answer a simple question such as, "how old are you?", and "where are you living now?", with the help of lip reading. At the

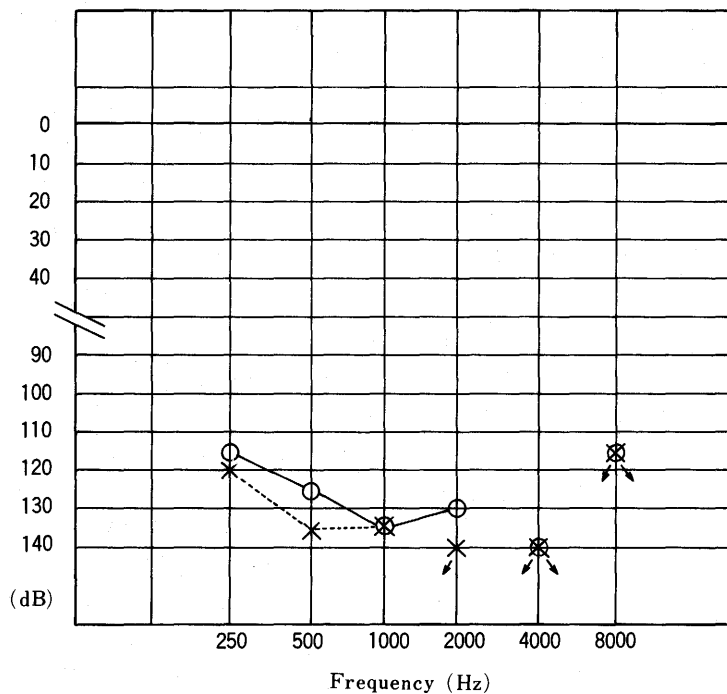


Fig. 2. Pure tone audiogram : Patient 2.

sixth week, he could clearly hear environmental sounds, such as a stream or a dog barking. He began to help in household matters when he temporarily went back to his house. In the seventh week, he met with his relatives and he could communicate with them.

## (2) Patient 2

When he first used the implant device, he described the sound he heard as noise from a broken radio or a garbled voice. Before he had become familiar with the sound, he often complained that the sound was too loud and too high-pitched. We changed the speech processor coding. He tended to compare his results of the auditory discrimination test with those of other patients. The worse were his auditory results, the less was his desire for rehabilitation. He was not willing to do speech tracking. Therefore we used free conversation. He gradually came to understand the limitation of the speech processor adjustment and the need to be familiar with the sound from his implant device. Three weeks after he could make a simple conversation with the help of lip reading and at the fifth week he returned to his job.

## 2) Assessment of speech recognition ability

As shown in Figure 3, the vowel recognition ability in Patient 1 was 80 % at

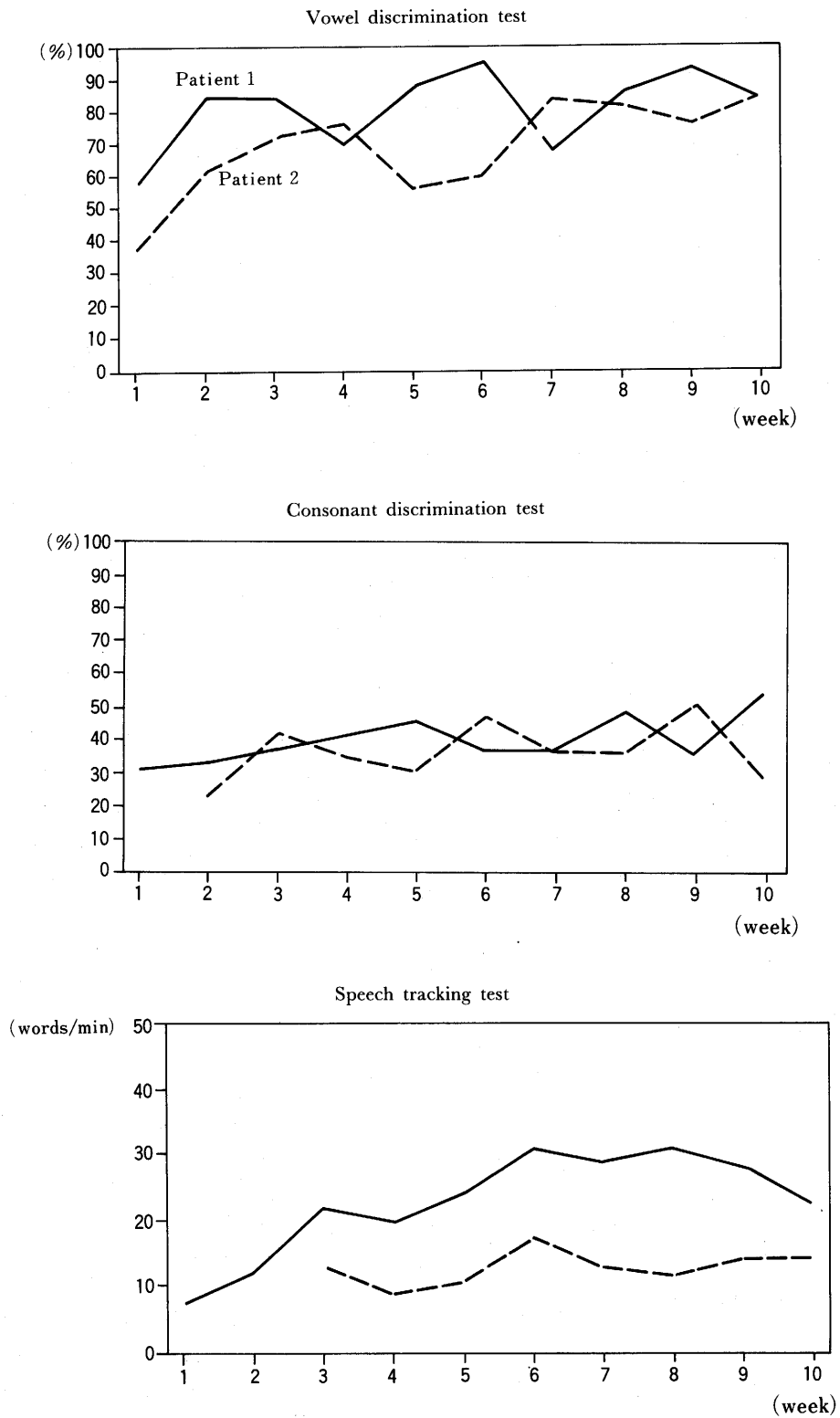


Fig. 3. Assessment of speech recognition ability.

the second week and over 90 % at the sixth week. In Patient 2, it was 70 % at the fourth week and over 80 % at the seventh week. The consonant recognition ability was about 40 to 50 % at the third to fourth week for both patients and did not improve any more. The speech tracking ability of Patient 1 was over 30 words per minute at the sixth week. On the contrary, that of Patient 2 did not reach 20 words per minute even at the tenth week.

### 3) Psychological and behavioral assessments

The results of the preoperative Y-G test was A type for Patient 1 and AD type for Patient 2. The psychological stability and social adjustment of the two cases were good. However, the result of the Sentence Completion Test (SCT) in Patient 2 showed the self defense aspect, because he did not answer eight questions among thirty questions.

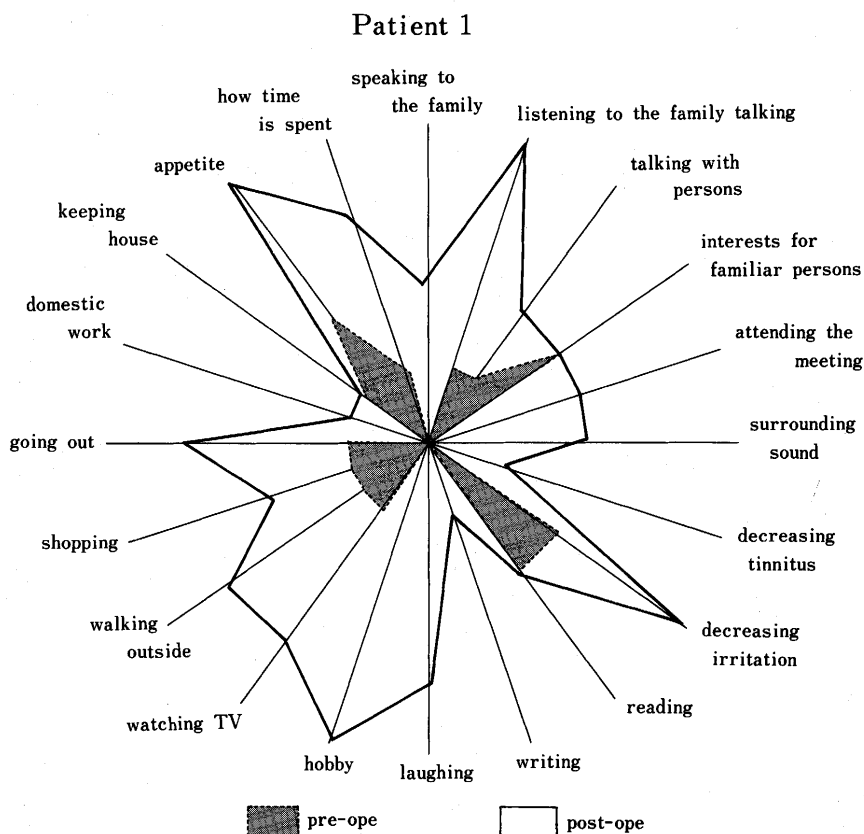


Fig. 4. Result of psychological and behavioral questionnaire.

Figures 4 and 5 show the interviews and questionnaires for behavioral and social life. The psychological and behavioral activity in Patient 1 during the deaf period was poor, but became very active after he regained the auditory ability. On the contrary, the results of pre- and post-operation in Patient 2 did not change

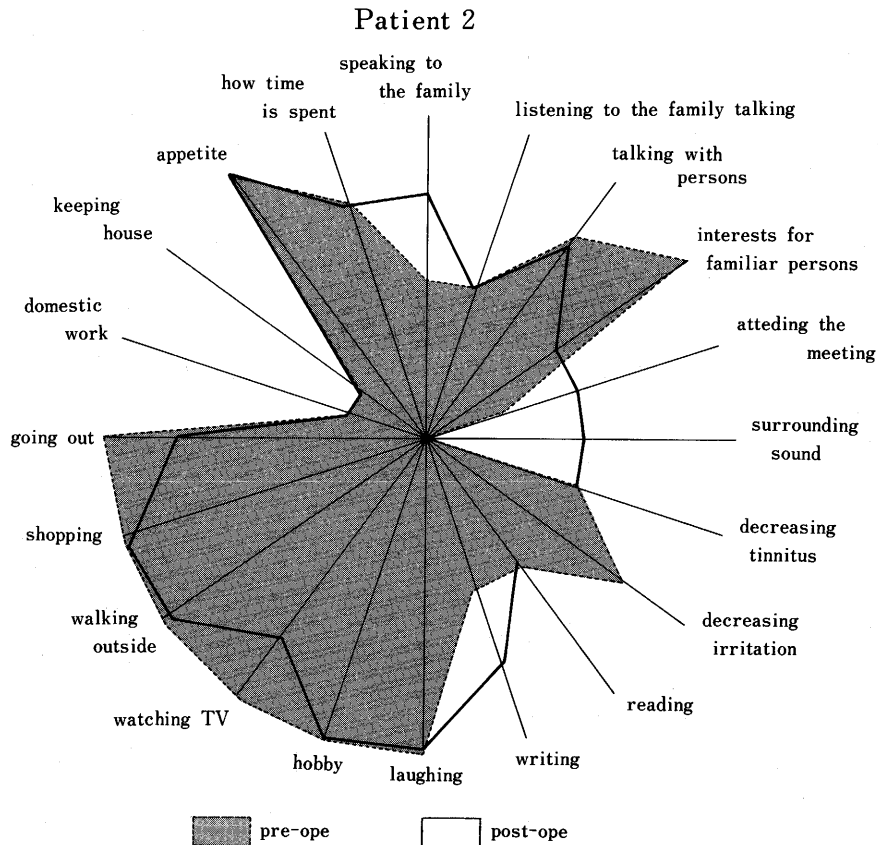


Fig. 5. Result of psychological and behavioral questionnaire.

remarkably.

## V. DISCUSSION

### 1) Rehabilitation

The first impression of the speech sound was different between Patients 1 and 2 and the improvement courses of auditory and social ability between the patients were also different. Patient 1 felt very happy to hear the sound from the implanted device. The rehabilitation course of this patient went more smoothly than we had expected. On the contrary, Patient 2 complained saying "the new sound was much different from that I had heard before deafness". From our clinical experience, counseling seemed to be a very important factor for the postoperative rehabilitation process. Patients are expecting much of the cochlear implantation. There is usually great excitement at the first testing session as the device is functioning and they can hear the sound. Later some patients, as in Patient 2, may feel disappointment as they realize the limitation of the prosthesis. It is important to prepare the patients for these situations before the operation. One aim of the preoperative psychological examination is to characterize psychological

and social inadequacy and to make use of the results for the postoperative rehabilitation program. Some patients tend to be impatient and uneasy. The speech therapist should try to make the patient feel at ease and to understand the patient's psychological conditions and to set up a comfortable condition where patients can tell speak frankly. For example, in Patient 2 we grasped the psychological tendency of the patient by means of preoperative assessments and devised a program that he was willing to do.

It seems to be important to recommend the patients to hear environmental sounds<sup>6)</sup>. Hearing an automobile and bike sounds, the patients feel safe to walk outside and listening to birds singing seems to increase their enjoyment for life. Some patients do not want to go outside. In Patient 2, the speech therapist needs to walk outside together. For the patients, hearing environmental sounds was very useful to know the advantage and limitation of the cochlear implant.

## 2) Assessment of speech recognition ability

The assessment of speech recognition ability was done by vowel and consonant discrimination tests and speech tracking test. The results of most tests reached a plateau within six or seven weeks after the beginning of rehabilitation. Around this period, the patients said that they hear the sound as a real sound through an implanted device.

In English speaking areas, MAC battery is used to assess speech recognition ability<sup>7)</sup>. This battery consists of 14 tests, such as discrimination of accent, intonation and environmental sounds. We are now preparing a new battery suitable for Japanese.

## 3) Psychological and behavioral changes

During the rehabilitation period, we become aware of the patients' psychological and behavioral change after the operation. For the cochlear implant patients, it is necessary to perform psychological tests before the operation to grasp the life situation during the time of deafness. It is useful to include these psychological and behavioral tests in the rehabilitation program. If a patient has some negative attitudes to the outside during the time of deafness, in Patient 1, the speech therapist should help the patient to be active after surgery.

To obtain objective data we used interviews and a questionnaire. The difference in results between Patients 1 and 2 seemed to be due to the fact that Patient 2 had been working during the long deaf period with many social activities. On the other hand, the preoperative and postoperative results in Patient 1 were much different. From the results obtained in Patient 1, cochlear implantation seems to be beneficial for not only for providing auditory ability, but also for improving psychological and behavioral aspects.



## VI. SUMMARY

1) The preoperative psychological and behavior assessments are important to correct psychological and social inadequacy in cochlear implant patient. 2) The postoperative rehabilitation program is divided into auditory training, psychophysical evaluation and counseling. 3) The auditory recognition ability seems to have reached a plateau within six or seven weeks after the beginning of rehabilitation.

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